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POPULATION ANALYSIS AND FORECASTS: DATA PROCESSING REQUIREMENTS

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DATA PROCESSING REQUIREMENTS:
POPULATION ANALYSIS AND FORECASTS

With Addenda

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BOSTON REDEVELOPMENT AUTHORITY

February 13, 1962

ADDENDUM 1

This addendum is to be considered as a continuation of page ten of the February 13, 1962 statement of the Boston Redevelopment Authority entitled "DATA PROCESSING REQUIREMENTS: POPULATION ANALYSIS AND FORECASTS" and the final portion of the subsection on "Historical Analysis" beginning on page nine.

It must be recognized that the average five year rates of change generated by equasion (IV) delineated in the above mentioned statement does involve assumptions that may not be entirely correct in all cases. As an additional technique to check the rates produced by equasion (IV) the historical analysis is to be performed also in the following manner. The general equasion expressing the change in total population in terms of the age cohorts is

$$\begin{aligned} 50,59^{C}T \;=\; & 55,59^{r}c{=}1\; 55,59^{B}T \;+\; 50,54^{r}c{=}1\; 50,54^{B}T \;+ \\ & 55,59^{r}c{-}2\; 55^{P}c{=}2 \;+\; 50,54^{r}c{=}2\; 50^{P}c{=}2 \;+\; \cdots \\ & 55,59^{r}c{=}15\; 55^{P}c{=}15 \;+\; 50,54^{r}c{=}15\; 50^{P}c{=}15 \\ & 55,59^{r}c{=}16\; 55^{P}c{=}16 \qquad 50,54^{r}c{=}16\; 50^{P}c{=}16 \cdot \end{aligned}$$

where

r is defined here differently from the definition in the original statement. Here it is defined as the percentage of the cohort population that does not remain in the cohort until the end of the period.

This equasion is merely a summation of the change in each age cohort during the first and the last half of the 1950 decade.

This equasion is employed along with the definitions expressed in equasion (IV) cited above to solve for values of "r." It will be noted that there are insufficient restraints to achieve a solution with only the general equasion. This is because the 1955 age cohort population is not known and must be generated. Thus, to provide the required restraints, it is to be assumed initially that the rates of change for any age cohort are the same for each half of the 1950 decade. This assumption allows for the solution of the rates by first determining the rate for the children born between 1955 and 1959 and then working through the other age cohorts in sequence by calculating absolute change and substituting rates for allocating between periods. The mathematics involved is simple up until the last three cohorts. There a solution of a quadratic equasion is required.

ADDENDUM 2

This addendum is to be considered as a continuation of the section dealing with "Rate Adjustment Procedures" currently finishing up on page 19 of the February 13, 1962 statement of the Boston Redevelopment Authority entitled "DATA PROCESSING REQUIREMENTS: POPULATION ANALYSIS AND FORECASTS."

The above systems for rate adjustment are established to generate a multiplier which is used to blow up the rates of change in proportion to their absolute value to the point where they produce the desired change. For some areas and some populations where the desired change is great or where the historical rate of change is great, there is the possibility that this process will generate rates that will produce a negative age cohort population. In these cases the projections are trivial.

Accepting the fact that some of the forecasts generated via the use of this rate adjustment technique will prove trivial, the following technique for rate adjustment is to be performed in addition to the one cited above for all forecasts where rate adjustments are required.

The basic procedure is to determine the amount of change required and the change that would be produced if the old rates or the historic rates are employed for making the forecast just as was done before; see equasions (VI) and (VII) in the original statement. However, instead of dividing out as before to generate the correction or adjustment factor, the multiplier, the difference between them is determined, viz.,

$$C_T = C_n - C_o$$

and the result, "C_T," is employed to adjust the old rates of change according to the following formulation.

$${}_{t,t+4}r_{c=n} = {}_{t-5,t-1}r_{c=n} + C_T$$

This formulation is employed for adjusting rates when the stability of death rates are not considered inasmuch as its use in the second adjustment procedure would produce exactly the same adjusted rates. The reason for this is that it doesn't matter whether the addition of "C_T" is made to the total rate or to that portion of the total rate caused by migrations. The result is the same; see equasion (XV).

Hence, three, rather than two, rate adjustment procedures are to be employed in making all forecasts, three are specified, where rate adjustments are required.

ADDENDUM 3 - March 12, 1962

This addendum describes in more detail the sort of summaries to be made for the purpose of reconciling the various population forecasts.

A total of nine forecasts are to be made from the basic information provided; they are:

Symbol	Forecast
A	White Male
B	White Females
C	Total White
D	Nonwhite Males
E	Nonwhite Females
F	Total Nonwhite
G	Total Males
H	Total Females
I	Total Population

Given the above symbols for the various forecasts, the following correlations are to be made by age group and summaries of age groups for the various census tracts, adhoc areas and for the city of Boston.

A + B - C
D + E - F
D + F - I

A + D - G
B + E - H
G + H - I

A + B + D + E - I

The format for the print off of this information is shown in Exhibit H and I.

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The following statement delineates the data processing requirements and processes for the phase of the population study for Boston concerned with the preparation of demographic analysis and forecast for each of 156 census tracts in the city. Approximately ten thousand cards, if punched cards are used, will be made up from basic data sheets.

Two distinct phases of the work are delineated. Each phase will be performed approximately one month apart. Phase one will involve the preparation of all cards required for both phases, about 10,000. Phase one involves the computation and output of four six digit numbers for each of the 500 cards requiring, however, the running of all cards. A listing of the numbers is to be prepared along with appropriate coding information.

Phase two will involve up to about 9,500 cards. The computations to be performed with these cards are intricate involving the use of information generated from previous cards. In addition, the information must be rearranged from the most convenient foremat for computation to the desired foremat for reports. The computations involve the following items, viz., two projections of future population using

historical rates of change; projections of population, about three sets, given predetermined totals and two processes for modifying the rates of change used in each set. Summaries of projection are to be prepared also. Reports will be required for each projection delineating the population projections, the rates employed to produce the projections, summaries and appropriate coding information.

The following is a preliminary detailed delineation of the basic information required to prepare a data processing program and an estimate of the cost of the work. As such the media from which the calculation will be made is described, the process to be used in making the calculation is delineated, and the end products sought are specified.

MEDIA

The work will involve two basic media from which the basic data for processing will be obtained. The two media are called by the name of the process for which they will be used. The first of these is computation of the birth and death factors. The second is the preparation of population analysis and forecast.

Birth and Death Factor Media

The basic input control figures, for calculating birth and death factors, the coding for organizing the information and the required outputs are as follows. The number of cards to be prepared will be about 500.

Item	Symbol	Columns
CODING INFORMATION		
Census Tract Designation*		3
Code for Designating Deck		1
INPUTS		
1950-54 Recorded Births	$50\text{-}4^{B}a$	4
1955-59 Recorded Births	$55\text{-}9^{B}a$	4
OUTPUT		
1950-54 Birth Factor*	$50\text{-}4^{X}$	6
1955-59 Birth Factor*	$55\text{-}9^{X}$	6
1950-54 Death Factor*	$50\text{-}9^{Y}$	6
1955-59 Death Factor*	$55\text{-}9^{Y}$	6
TOTAL		29

*Items to be included in reports in that order on a line.

Analysis and Forecast Media

The following is a listing of the basic information required for making analyses and forecasts, the required output and the coding for organizing the information. In this series, about 9,500 cards will be required.

Item	Symbol	Minimum Column
CODING INFORMATION		
Census Tract*		3
Race*		1
Sex*		1
Age*		5
Deck Identification		1
INPUTS		
1950 Population*	$50^{P}c=n$	6
1960 Population*	$60^{P}c=n$	6
1960 Population	$60^{P}c=n+2$	6
Birth Factor*	X	6
Death Factor*	Y	6
OUTPUTS		
1965 Population*	$65^{P}c=n$	6
1970 Population*	$70^{P}c=n$	6
1975 Population*	$75^{P}c=n$	6
Historical Rate of Change*	$^{r}c=n$	5
1960-64 Rate of Change*	$60\text{-}4^{r}c=n$	5
1965-69 Rate of Change*	$65\text{-}9^{r}c=n$	5
1970-74 Rate of Change*	$70\text{-}4^{r}c=n$	5
TOTAL		79

*Items to be included in reports in that order, on a line with birth and death factors at end of line.

PROCESS

The following is a description of the processes mentioned above. The processes to be performed during phase one consists of analyzing the rate of change of cohort populations between 1950 and 1959 and computing the birth and death factors which are ratios for each tract describing the variation of fertility and death rates in that tract vis a vis the average for the city. During phase two the Analysis and Forecast media only is used although with additional imputs. The phase two involves the preparation of two population forecast based upon rates and factors during the historical analysis performed during phase one and the preparation of other forecasts based upon input controls for adjusting the historical rates of change.

Phase One Computations

Phase one involves the computation of historical birth and death factors and historical rates of change. The objective sought in computing birth and death factors is to develop specific fertility and death rates for each census tract in the city. This is to be achieved by measuring the extent to which the rates in each tract vary from the fertility and death rates

for the entire city. This procedure assumes that the relative value of fertility and death rates between age groups in any census tract is the same as for the entire city and that all of the rates for any tract are a constant multiple of the rates for the city. Two birth and two death factors are to be computed, i.e., one each for the first and the last half of the 1950 decade.

Computation of Birth Factors

The process for making these computations consists of the following steps. Step one is the computation of the births that could be expected during the periods 1950-54 and 1955-59 in each census tract if the fertility rates in that tract were the same as those for the entire city. Two sets of fertility rates for the entire city distinguishing between white and non-white females are to be provided for this purpose and are labeled thus:

Symb.	Cohort	Fertility Rates White	 Non-White
$b_c=5$	15-19	.0796	.1101
$b_c=6$	20-24	.3239	.3517
$b_c=7$	25-29	.3008	.2699
$b_c=8$	30-34	.1938	.1483
$b_c=9$	35-39	.1106	.0805
$b_c=10$	40-44	.0221	.0085

The formula to be employed for the computation of births by mothers in each age group is:

$$ {}_{t,t+4}B_{c=n} = b_{c=n} + k({}_{60}P_{c=n+2} - {}_{50}P_{c=n})) \qquad (I) $$

where

${}_{t,t+4}B_{c=n}$	is the number of births occuring during the years "t" through "t+4" among females in the "n" age group "c",
${}_{50}P_{c=n}$	is the 1950 female population in the "n" age group,
${}_{60}P_{c=n+2}$	is the 1960 female population in the "n+2" age group (since in 1960 the population will be 10 years older) and,
k	is a constant factor to determine the population at the middle of the analysis period, i.e., 1952½ and 1957½. In making the analysis for the period 1950-54 k = .25 while in making the analysis for the period 1955-59 k = .75

Thus the total births for any half decade period is determined by summing up the births produced by females in each of the six age groups, viz.,

$$ {}_{t,t+4}B_T = \sum_{n=5}^{n=10} {}_{t,t+4}B_{c=n} \qquad (II) $$

Step two involves the computation of the birth factors for each half decade period by dividing the actual or recorded

births into the number of births computed above based upon the use of average fertility rates for the entire city. The formula expressing this computation is as follows:

$$_{t,t+4}X = \frac{_{t,t+4}B_T}{_{t,t+4}B_a} \qquad \text{(III)}$$

where

$_{t,t+4}X$ is the birth factor "X" for the period "t" through "t+4",

The output for this process is the birth factors for t = 1950 and for t = 1955.

Computation of Death Factors

The process for computing the Death Factors is very similar to that for computing Birth Factors. City wide death rates are provided for computing the deaths in each census tract that would occur if the rates in each tract were the same as for the entire city. These deaths are compared with actual recorded deaths to develop the death factor. The age specific death rates for the city are labeled as follows.

		Survival Rates			
	Age	White		Non-white	
Symb.	Cohort	Male	Fem.	Male	Fem.
$d_{c=1}$	0-1	.9735	.9799	.9520	.9602
$d_{c=2}$	1-4	.9958	.9965	.9919	.9930
$d_{c=3}$	5-9	.9974	.9982	.9965	.9970
$d_{c=4}$	10-14	.9972	.9984	.9955	.9976
$d_{c=5}$	15-19	.9962	.9972	.9917	.9951
$d_{c=6}$	20-24	.9945	.9969	.9865	.9921
$d_{c=7}$	25-29	.9930	.9961	.9814	.9886
$d_{c=8}$	30-34	.9910	.9948	.9766	.9831
$d_{c=9}$	35-39	.9829	.9923	.9668	.9377
$d_{c=10}$	40-44	.9874	.9880	.9550	.9665
$d_{c=11}$	45-49	.9649	.9814	.9335	.9487
$d_{c=12}$	50-54	.9416	.9716	.9047	.9241
$d_{c=13}$	55-59	.9110	.9569	.8582	.8882
$d_{c=14}$	60-64	.8660	.9295	.8000	.8280
$d_{c=15}$	65-69	.8070	.8785	.7400	.7640
$d_{c=16}$	70+	.7040	.7850	.6000	.6500

The formula employed for making these calculations is the same as formula (1) except that "d" is substituted for "b". The computation of total deaths in the tract is determined by a formulation the same as formula (II) except that the summation of deaths "D" is made over the entire range of from "n=1" to "n=16". The computation of the death factor "Y", is achieved by dividing this sum by the actual recorded number of deaths recorded during the period. This is the same procedure delineated for the computation of the birth factors shown in formula (III).

Historical Analysis

The historical analysis of census tract population has as its objective the development of five year rates of change for age cohorts. For each census tract there will be a minimum

of three components of thetotal population (male, female & total population), each having sixteen cohorts to be analyzed. For those tracts where white and nonwhite population is analyzed separately, the number of components treated is nine.

Historical rates of change for each age cohort are to be developed according to the following formulation.

$$r_{c=n} = 1 + \frac{.5(60P_{c=n+2} - 50P_{c=n})}{50P_{c=n}} \qquad \text{(IV)}$$

where

$r_{c=n}$ is the historical five year net survival rate of change for age group "n" and where the value of "n" is equal to or greater than two.

For the value of "n=1" formula (VI) is modified by dropping out the ".5" because the analysis period will be five years, i.e, half as long as the period for the other age cohorts.

PHASE TWO COMPUTATIONS

The work in Phase Two is basically that of preparing population forecasts and summaries of these forecasts. The work may be viewed as consisting of the following components inasmuch as two basically different forecasts are to be prepared. The first type is based upon the extrapolation of historical trends. Two forecasts of this type are to be made; one based upon historic rates of change "r," and one based upon historical birth and death rates. The second type of forecast is based upon an input of an overall control or conditions to which the forecast must conform. Three such forecasts are contemplated. For each of the contemplated forecasts two techniques for adjusting the rates of change will be used thereby producing two forecasts for each condition. The final work involved in this phase is the preparation of summaries for all of the forecasts.

Basic Projection Procedures

The following is a description of the basic processes to be followed in the preparation of forecasts. The basic formulation to be used in making all projections is

$$ {}_{t+5}P_{c=n+1} = r_{c=n}\ {}_{t}P_{c=n} \qquad \text{(V)} $$

It is important to note that the value of "c" must be equal for "r" and for "P". As expressed in equasion (V) the value of "c" for any age cohort increase by "1" for each five year period hence that the population is projected to. This is because the population is five years older after each projection. Thus in the following table it can be seen that the value of "c" increases by "1" for the rates used for each five year period over which the population is projected.

1960 Age Group Population	Age Group Rates For Projecting To 1965	1970	1975
$60^{P}c=16$	$r_{c=16}$	$r_{c=16}$	$r_{c=16}$
$60^{P}c=15$	$r_{c=15}$	$r_{c=16}$	$r_{c=16}$
$60^{P}c=14$	$r_{c=14}$	$r_{c=15}$	$r_{c=16}$
$60^{P}c=13$	$r_{c=13}$	$r_{c=14}$	$r_{c=15}$
$60^{P}c=12$	$r_{c=12}$	$r_{c=13}$	$r_{c=14}$
$60^{P}c=11$	$r_{c=11}$	$r_{c=12}$	$r_{c=13}$
$60^{P}c=10$	$r_{c=10}$	$r_{c=11}$	$r_{c=12}$
$60^{P}c=9$	$r_{c=9}$	$r_{c=10}$	$r_{c=11}$
$60^{P}c=8$	$r_{c=8}$	$r_{c=9}$	$r_{c=10}$
$60^{P}c=7$	$r_{c=7}$	$r_{c=8}$	$r_{c=9}$
$60^{P}c=6$	$r_{c=6}$	$r_{c=7}$	$r_{c=8}$
$60^{P}c=5$	$r_{c=5}$	$r_{c=6}$	$r_{c=7}$
$60^{P}c=4$	$r_{c=4}$	$r_{c=5}$	$r_{c=6}$
$60^{P}c=3$	$r_{c=3}$	$r_{c=4}$	$r_{c=5}$
$60^{P}c=2$	$r_{c=2}$	$r_{c=3}$	$r_{c=4}$
$60\text{-}64^{B}$	$r_{c=1}$	$r_{c=2}$	$r_{c=3}$
$65\text{-}69^{B}$	-	$r_{c=1}$	$r_{c=2}$
$70\text{-}75^{B}$	-	-	$r_{c=1}$

It will be noted that the same rates are employed for age cohort "16" to project the population to 1965, 1970 and 1975. This is because this age cohort is the last one delineated and the population entering it never can advance out of it but rather are joined population in the next previous age cohort for each five year projection.

The process for making all projections is to first project the female population and at the same time compute the total number of births that may be expected during the interval. This will involve the use of the city wide fertility rates and the birth factors that will be selected and provided subsequent to their preparation during phase one and before the beginning of work during phase two. The formula for computing births for each age cohort of reproductive females is.

$${}_{t,t+4}B_{c=n} = .5\ b_{c=n} \text{ X } P_{c=n}(r_{c=n} + 1) \qquad \text{(Va)}$$

The total births for the period "t" through "t+4", ${}_{t,t+4}B_T$, is the sum of the births produced by each female age cohort. This has been expressed already in formula (II).

The last female cohort to be projected consists of the female births that occurred during the period. 48.3 percent of the total births are taken as the female births and are projected in the same way as any other age cohort, i.e., using equasion (V). Subsequently, the male and total population are projected employing in addition to 1960 population figures the births computed earlier.

The required output for these computations is the projection of age cohort population along with 1950 and 1960 population, the rates of change used to make the projections, and appropriate coding and identification information.

Eight population projections are to be prepared for each tract. Two of the eight will be prepared solely from unadjusted information generated during phase one. One will be the projection based upon the historical gross rates of net change determined for each cohort during phase one. Formula (V) is to be used in making the projection wherein "$r_{c=n}$" is the historical gross rate of net change. In the other forecast, death rates will be employed and substituted for the age cohort net rate of gross change. Thus equasion (V) may be rewritten for this calculation as follows.

$$_{t+5}P_{c=n+1} = {}^{d}{}_{c=n}\ {}_{t}P_{c=n} \qquad \text{(Vb)}$$

For the six of the eight forecasts, the rates employed for making the projections must be generated by adjusting the historic net rates of gross change. The following is a description of the procedures to be used in making the adjustments.

Rate Adjustment Procedures

As mentioned above, two techniques are to be employed for adjusting rates such that their use will produce a projection that conforms with given conditions. The basic projection procedure is employed in making these forecasts, however, the rate adjustment processes are to be employed in addition.

The two rate adjustment techniques described below are similar in regard to the mathematics used. The first technique

to be described adjusts the entire rate of change. The second technique distinquished between change caused by deaths and change caused by migrations and adjusts the migration rate only leaving the death rate unadjusted.

The sequence of steps to be followed in the first rate modification routine are as follows. Step one is to determine amount of change in total population that would occur during the projection interval if the rates used to project over the previous interval are used. This change "C_o" is computed as follows.

$$C_o = {}_{t+5}P_T - {}_tP_T \qquad \text{(VI)}$$

The desired change in total population "C_n" which the rates are being adjusted to produce is determined by

$$C_n = {}_{t+5}P'_T - {}_tP_T \qquad \text{(VII)}$$

where

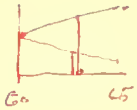
${}_{t+5}P'_T$ is the predetermined total population to be generated by the adjusted rates.

$${}_tP_T = {}_{t,t+4}B_T + {}_tP_{c=2} + \ldots\ldots\ldots + {}_tP_{c=16}$$

$${}_{t+5}P_T = {}_{t+5}P_{c=2} + \ldots\ldots\ldots + {}_{t+5}P_{c=16}$$

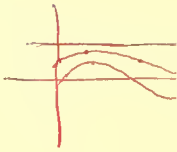
Step two is to determine the variance of change "C_t" produced by the old rates of change vis a vis the change that must be induced to generate the desired total population, "${}_{t+5}P'_T$." This is achieved by developing the ratio of the two changes as follows:

$$C_T = \frac{C_n}{C_o} \qquad \text{(VIII)}$$



In step three this ratio is employed to modify the age group rates of change used during the previous period, "t-5" through "t-1," to develop new rates of change to be used for projecting age cohort population through the subsequent period, "t" through "t+4." The formula for adjusting rates is as follows.

$$ {}_{t,t+4}r = 1 + C_T \left({}_{t-5,t-1}r - 1 \right) \qquad \text{(IX)} $$



After the development of the new rates they are used to make a projection based upon the process outlined above. The projection is made for the interval "t" through "t+4" to the year "t+5." It is quite likely that the initial modification of rates will not produce exactly the desired projection of population, i.e., meet the control conditions exactly. This is because changes in the rate of change produce also changes in the number of births that occur during the period. This occurs because the births are based upon the average population during the period rather than merely the initial population. Thus as the rate of change varies so also will the average population.

The procedure to be followed in developing rates that achieve the desired objective is to make subsequent adjustments in the rates until they produce the desired population. The procedure is a calculating loop wherein the rates are adjusted such that the difference between the forecasted population and the desired population is successively reduced. This operation is described as follows. The loop is entered by making rate adjustments

and population projections. The sum of the age group projections is then compared with the desired change to determine if they are equal. If they are equal the forecasts and the rated employed are set up for output. If they are unequal the rates must be readjusted by entering in again at the beginning of the loop and computing a new value for "C_T" wherein "C_n" retains its original value and "C_o" assumes a new value based upon the last forecast made (See equasion (VI)). Next the new value of "C_T" is multiplied by the old value to produce a new factor to be used next in modifying the original rates as per equasion (IX). The process as defined above is completed to the end of the loop. The program will continue to loop until the desired change equals the change induced by the rates in the latest projection. Three or four loops should be adequate to achieve this.

The second technique for rate adjustment takes cognizance of the relative stability of death rates vis a vis the wide variability of migration rates. Hence, the objective of this technique is to hold the death rates constant while adjusting only that share of the total rate of change that is caused by migrations.

The procedure for doing this is as follows. First the total change based upon the use of the old rates is calculated as before using equasion (VI). In addition, the change that may

be attributed to deaths is calculated. The difference between the total change produced by the old rates and the change caused by deaths is considered as the change caused by migrations. This calculation is described in the following formula.

$$\begin{aligned} C_m &= C_o - C_d \\ &= P(r_o - 1) - P(d - 1) \\ &= P(r_o - d) \end{aligned} \qquad \text{(X)}$$

where

C_o is as defined in equasion (VI),

C_m is the portion of total change that may be attributed to migrations

C_d is the portion of total change that may be attributed to deaths, and

d is the age specific survival rate.

For the purpose of modifying equasion (VIII) to suit the objectives of this rate modification routine, let

$$C_m = C_o \qquad \text{(XI)}$$

where

C_m, is as defined in equasion (X)

and let "C_n" in equasion (X) assume the following identity.

$$C_n = {}_{t+5}P'_T - {}_{t}P_T + C_d \qquad \text{(XII)}$$

By this means the change that will be caused by deaths may be discounted and the rate of migration may be changed to achieve the purpose of the adjustment. Thus the process to be employed for

determining the modifying factor is the same as before, i.e.,

$$C_T = \frac{C_n}{C_o} = \frac{C_m}{{}_{t+5}P'_T - {}_tP_T + C_d} \qquad \text{(XIII)}$$

with the values assuming the new identities cited immediately above.

In adjusting the migration rates, the death rates are not adjusted, the same procedure as before, i.e., equasion (IX), is employed but with substitutions, viz.,

$${}_{t,t+4}m = 1 + C_T({}_{t-5,t-1}m - 1) \qquad \text{(XIV)}$$

where

m is one plus the net migration rate.

One additional computation is required to develop the new total rate "r'" and that is to merge the old death rate with the newly adjusted measure of migration. This is achieved in the following manner.

$$r' = d + m - 1 \qquad \text{(XV)}$$

Having derived the new rates of change in this manner, projections are made and the change caused is compared with the desired change for determining whether subsequent modification is required in the calculating loop as before.

Summary Programs

Two summary programs are to be performed. The first of these is to prepare population summaries by special areas, GNRP

and Project areas, consisting of a number of whole and partial census tracts. The second is to be a summary of age group populations for each census tract by components of the total population.

The special summaries by GNRP and Projects are to be prepared for all population analyses and forecasts and the summaries by age groups. The summaries will be based upon directions provided for allocating entire and partial census tracts to various GNRP and Project areas. It is expected that these summaries will include population figures as well as rate of change figures that would have been used if projections and analyses had been prepared using these geographical delineations. Thus this may require rerunning the historical analysis program of phase one to recompute the rates of change for these areas, these aggregates of census tracts. The foremat of the report is to be essentially the same and include all items that are shown for census tract analyses and forecasts.

The second summary of age group population will involve the adding together of the parts, recording the sum for output, subtracting the sum from the independent projection of the whole and recording the difference for output.

In general a summary of male and female population by age group for each tract is to be made and compared with the independent projection of the total population. However, in

those census tracts where white and nonwhite population are analyzed and forecasted independently additional summaries and comparisons are to be made. The following are the additional summaries for about sixty census tracts.

a) Summaries of nonwhite and white females compared with total female forecasts.

b) Summaries of nonwhite and white males compared with total male forecasts.

c) Summaries of male and female white population compared with total white population forecasts.

d) Summaries of male and female nonwhite population compared with total nonwhite population forecasts.

e) Summaries of total white and total nonwhite population compared with forecasts of total population forecasts.

REPORTS

Six copies of all required reports are to be prepared and delivered to the Authority. All reports are to have the proper column heading on each sheet along with the designations required to properly identify each projection and each part of each projection and notations of symbols and abbreviations used.

Three different types of reports will be required. One type will present the computations of birth and death factors. Another type will be the results of the historical analysis and forecasts of population. The third type delineates the age group summaries and comparisons with independently projected totals.

Type one report will list the computed birth and death factors computed during phase one for each census tract in the city. One set of six copies of this report is required.

Type two reports are to be prepared at the end of phase one and phase two. After phase one a single report of six copies is to be prepared delineating the results of the historical analysis. After phase two, eight reports of six copies each are to be prepared; one for each of the eight forecasts. The following is a list of the forecasts to be reported on.

a) A forecast using the historical rates of change derived during phase one.

b) A forecast using the city wide death rates and selected death factors.

c) Three other forecasts each employing the two systems of rate modification based upon input controls for adjusting the rates. This will require a total of six reports.

Type three reports are to be prepared subsequent to the preparation of the forecasts wherein there will be reported the summary of age group components and a comparison with age group totals. These are to be prepared for each of the forecasts noted above. Hence, eight type three reports of six copies each will be required.

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Population Analysis & Forecasts Data Processing Requirements

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